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NOTES FROM PACIFIC COAST OBSERVATORIES

NOVAE IN SPIRAL NEBULAE AND THE ISLAND UNIVERSE THEORY

A note in the preceding number of these *Publications* announced the discovery of four "new stars" in spiral nebulae; one at Mount Wilson in the nebula N. G. C. 6946, one at Mount Hamilton in N. G. C. 4527, and two at Mount Hamilton in N. G. C. 4321. Comments were added to the effect that these novae must actually be within the spiral nebulae, and therefore must be regarded as having a bearing on the "island universe" theory of the constitution of spiral nebulae. It seems desirable to amplify the latter idea.

The distribution of the new stars thus far observed, excluding the six found in spiral nebulae, shows that they are essentially a galactic phenomenon; in fact *T Coronae* is the only star amongst those called novae which lies outside the Milky Way, and *T Coronae* was not a typical nova. A limited number of novae—about 26—have been found in our Galaxy. The reasoning by analogy frequently leads to error, the occurrence of objects of the same type in the spirals would reasonably be expected, were these spirals in fact congeries of vast numbers of stars, like our own Galaxy.

The entire invisibility of many novae before and after their brief apparition period makes it possible to assume that they may well have increased in brightness at least sixteen magnitudes. On this rough assumption the novae in spirals would possibly have been of the thirtieth magnitude before their outburst. Stars of the fifteenth magnitude, in our own Galaxy, if assumed to be twenty thousand light years away at present, would have a distance of the order of twenty million light years in order to be of the thirtieth magnitude. An external galaxy at this distance, if 10' in apparent diameter, would have an actual diameter of nearly sixty thousand light years; not an impossible dimension, so far as we may judge from our very imperfect knowledge of the size of our own Galaxy. Nebulae 10' in diameter are the giants of the class; the smaller spirals would have to be ten to one hundred times more remote, unless their dimensions were considerably smaller than our Galaxy is believed to be.

There is another way of looking at the subject. The Harvard list* of novae contains 28 entries. Adding *Nova Geminorum* No. 2, of 1912, and excluding the nova in the Andromeda nebula and *Z Centauri*, the

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arithmetical mean of the maximum observed magnitudes of the 27 novae is $5\frac{1}{2}$. Some of the observed maximum magnitudes were visual and some were photographic, but the spectra of novae are rich in blue and violet light, and their color equation is therefore small. In several novae the maximum brightness occurred before their discovery, and we shall not be far wrong to assume that the average (arithmetical) maximum brightness of our galactic novae is 5. Presumably the novae already discovered in spiral nebulae are the brighter ones of their class; and there seems to be safety in setting 15 as the average maximum. There is thus an average difference of 10 magnitudes between galactic novae and spiral novae. Now all the evidence available assigns a great distance to the galactic novae. If we assume equality of absolute magnitude for galactic and spiral novae, then the latter, being apparently 10 magnitudes the fainter, are of the order of 100 times as far away as the former. That is, the spirals containing the novae are far outside our stellar system; and these particular spirals are undoubtedly, judging from their comparatively great angular diameters, the nearer spirals. Of course the effect of any existing absorbing materials in the spirals upon the novae is to reduce their apparent brightness and thus to make them seem farther from our system than they really are.

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NOTE ON THE BINARY STAR $\text{O}\Sigma\ 341$.

Notes* by Professor Husary in earlier volumes of these *Publications* called attention to the remarkable change observed in the double star $\text{O}\Sigma\ 341$ in the years 1898 and 1900. In the former year the distance between the two components, long regarded as relatively fixed at about $0''.4$, had become so small that the star appeared to be single with the highest powers of the 36-inch refractor. During the two following years the components were once more separately visible at distances of $0''.17$ and $0''.26$ respectively, and in 1915 my measures showed that they had again reached an angular separation of $0''.4$.

More recently I have secured the following measures:

1910.268	93°.2	0".48	1 ^a
1914.586	96 .2	0 .34	2
1916.605	96 .9	0 .24	3
1917.584	86 .5	0 .15	1

*Pub. A. S. P. 10, 121, 1898; 12, 38, 1900.